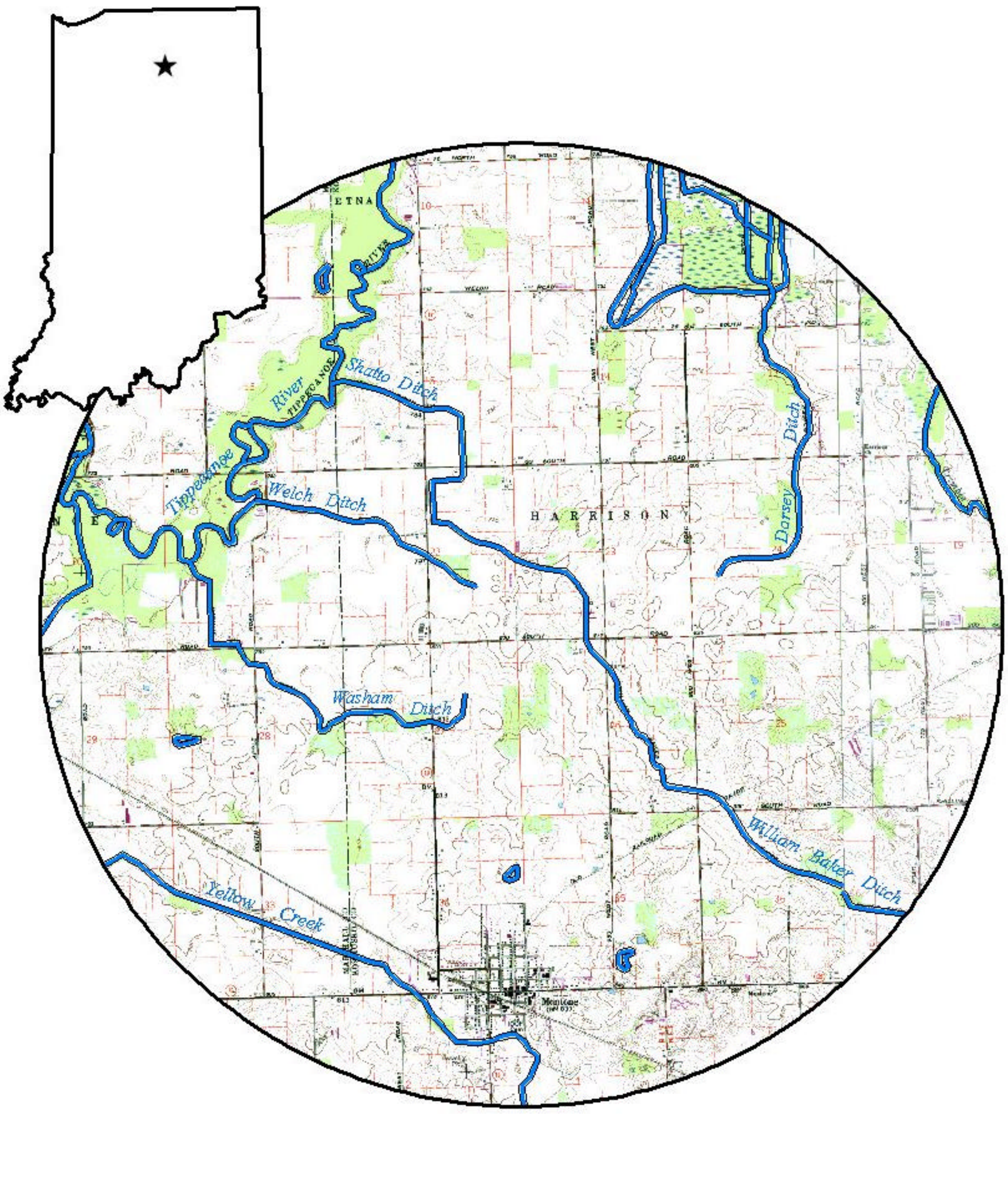
2001 Water Quality Study of William Baker Ditch, Shatto Ditch, and the Tippecanoe River



INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

IDEM

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

OFFICE OF WATER QUALITY

ASSESSMENT BRANCH

SURVEYS SECTION

FEBRUARY 2002

IDEM/32/02/029/2002

2001 Water Quality Study of William Baker Ditch, Shatto Ditch and the Tippecanoe River

By
Stephen H. Boswell, Senior Environmental Manager

Compilation and development of the final report was the primary responsibility of the Surveys Section
Arthur C. Garceau, Surveys Section Chief

Indiana Department of Environmental Management
Office of Water Quality
Assessment Branch
Surveys Section
February 2002
IDEM/32/02/029/2002

Notice and Disclaimer:

When citing this document:

Boswell S. 2002. 2001 *Water Quality Study of William Baker Ditch, Shatto Ditch and the Tippecanoe River*. Indiana Department of Environmental Management, Office of Water Quality, Assessment Branch, Surveys Section, Indianapolis, Indiana. IDEM 032/02/029/2002

Abstract

William Baker Ditch, downstream Shatto Ditch and the Tippecanoe River were sampled twice during the summer of 2001. Concern had been expressed by a local citizen that runoff from a confined feeding operation would pollute these streams. Water samples were collected during wet weather with runoff of adjacent fields and again during dry weather and low flow. Bacteriological contamination at nearly all sites occurred during both surveys. During wet weather, high nitrates were present as well, evidently from runoff. At one location, cattle and unprotected stream banks were observed, and the water quality reflects this. At another location, indications of a failing septic tank were observed. At other sampling sites, stream banks were covered with high grassy banks. Since bacterial contamination was present during runoff, it may be that better land application should be practiced, animals should be prevented from entering streams, and grassy banks should be placed where stream bank vegetation is sparse.

Other recommendations are for the Kosciusko County Health Department to investigate the failing septic system, The Kosciusko County Soil and Water Conservation District help landowners with Best Management Practices, and the ditch placed on the Clean Water Act 303(d) list if or when appropriate.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Indiana Department of Environmental Management (IDEM) received a letter from Mr. Robert Foltz, Mentone, (Foltz 2000) in which he stated his concern that an agribusiness had received IDEM approval (IDEM 2000) to convert a beef cattle confined feeding operation (CFO) into a chicken CFO upland and upstream of the Foltz farm property. According to Mr. Foltz, and from sampling analyses conducted by the Kosciusko County Health Department, past agribusiness practices caused water pollution to area streams because of over-application of manure. County tests revealed that all nitrate tests and *E coli* tests were at high levels from each of the drainage pipes sampled (Still, personal correspondence, undated). Additionally, samples collected by IDEM's Office of Land Quality indicated both high nitrates and high *E coli* values (Caylor 2000). Mr. Foltz stated other problems were apparent and were associated with improper operations and farming/land application practices. It states in 327 IAC 2-1-3 (IAC 2001), "All waters which are used for agricultural purposes must, at a minimum, meet the standards established in section 6(a)…which are minimum water quality standards". This survey was conducted to assess whether these waterbodies are in compliance with the Water Quality Standards.

Work plans (Boswell 2001) for this survey were developed with the following objectives in mind:

1. Identify if there are violations of surface water quality standards in William Baker Ditch, and,
2. Determine if deleterious conditions of the ditch contribute to the degradation of water quality in the Tippecanoe River.

Sampling was scheduled to occur during two periods:

1. During or just after wet weather caused runoff and elevated stream flows, and
2. In the late, dry summer weather, when pollution, if any, would be more concentrated in streams, and when the streams were at seasonally low stream flow.

METHODS AND MATERIALS

SAMPLING SITES AND LOCATIONS

Listed in the sampling plan for this survey (Boswell 2001) are 14 proposed sampling locations. Five sites were not sampled as they were on private property and, for this survey, thought not needed at the time to properly characterize the water, since the cattle CFO operation had ended and the chicken CFO had not been built. See Table 1 for a listing of the 9 sites sampled and Figure 1 for a map of the sampling sites. As clarification, Wm. Baker Ditch and Shatto Ditch are the same stream, with the name changed from Wm. Baker Ditch to Shatto Ditch at CR 950 W according to the Kosciusko County Surveyor's Office.

Figure 1 Sample Sites

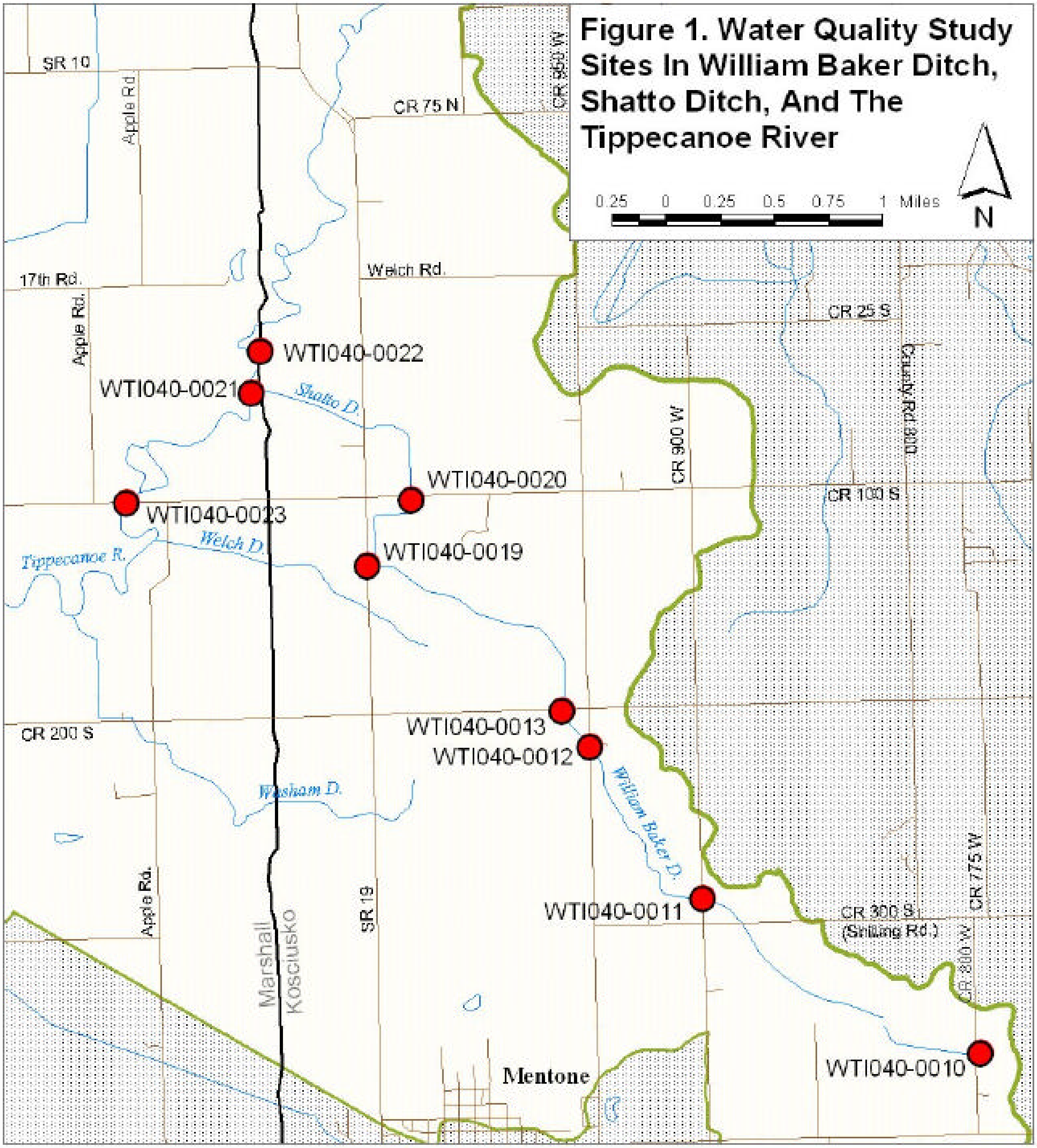


Table 1 Sites Included In Survey

Site Name	Stream Name	Description	14-Digit HUC	County Name	Latitude	Longitude
WTI040-0010	William Baker Ditch	Headwaters, above CR 780 W	5120106040010	Kosciusko	41 10 45	--85 59 29
WTI040-0011	William Baker Ditch	CR 900 W	5120106040010	Kosciusko	41 11 23	--86 0 56.8
WTI040-0012	William Baker Ditch	W side of CR 950 W	5120106040010	Kosciusko	41 12 0	--86 1 32.4
WTI040-0013	William Baker Ditch/Shatto Ditch	N side of CR 200 S	5120106040010	Kosciusko	41 12 8.65	--86 1 40.94
WTI040-0019	Shatto Ditch	Where Ditch Flows Parallel to SR 19	5120106040010	Kosciusko	41 12 44	--86 2 42.5
WTI040-0020	Shatto Ditch	At CR 100 S	5120106040010	Kosciusko	41 12 35.1	--86 2 7.58
WTI040-0021	Shatto Ditch	D/S of SR 19 and Just Upstream from Tippecanoe River Conf	5120106040010	Marshall	41 13 25.89	--86 3 18.98
WTI040-0022	Tippecanoe River	U/S of Conf with Shatto Ditch	5120106040010	Kosciusko	41 13 36	--86 3 16
WTI040-0023	Tippecanoe River	D/S of Conf with Shatto Ditch, at CR 100 S.	5120106040010	Marshall	41 12 59.77	--86 3 59

Individually the sites are described as follows:

1. **WTI040-0010**. Wm. Baker Ditch at CR 780 W. This site was considered headwaters, although it may be draining from a ponded area about 1/2 mile from the road. The ditch upstream of the bridge was difficult to discern because of the weeds covering the stream.

2. **WTI040-0011**. Wm. Baker Ditch at CR 900 W. Coming across open pasture, there was no stream cover or bank side vegetation at this site. Cattle had easy access to the stream.

3. **WTI040-0012**. Wm. Baker Ditch at CR 950 W. This stretch of the stream had high weedy banks.

4. **WTI040-0013**. Wm. Baker Ditch/Shatto Ditch at CR 200 S. The ditch passes through an open field. The farmhouse to the west, on the south side of the road, has what appears to be septic tank drainage entering next to the road, on the upstream side of the bridge.

5. **WTI040-0019**. Shatto Ditch where it runs parallel with SR 19. Ditch flows under weeds after crossing fallow croplands.

6. **WTI040-0020**. Shatto Ditch after crossing the Foltz property.

7. **WTI040-0021**. Shatto Ditch before confluence with Tippecanoe River. Samples were collected about 30 feet upstream of its mouth where the stream was visibly flowing and not pooled as backwater from the Tippecanoe River.

8. **WTI040-0022**. Tippecanoe River upstream of SR 19. This site represents background water quality before Shatto Ditch confluence.

9. **WTI040-0023**. Tippecanoe River downstream of Shatto Ditch confluence and just above CR 100 S. bridge. This site represents downstream effect or influence of Shatto Ditch.

WATER SAMPLE COLLECTION

Water quality samples were collected as grab samples by wading or from a boat. Wm. Baker Ditch and Shatto Ditch were sampled by wading into the stream at sites at or near road crossings. The Tippecanoe River sites and Shatto Ditch site just upstream of the confluence with Tippecanoe River were sampled by boat.

Samples were collected consistent with the methodology described in Surveys Standard Field Procedure Manual (Beckman 2000).

FIELD MEASUREMENTS

Hydrolab® Scout® multi-parameter instruments were used to simultaneously measure dissolved oxygen concentration and per cent saturation, pH, temperature and conductivity at the time water quality samples were collected. The units were calibrated prior to and after each survey.

STREAM FLOW MEASUREMENTS

There are no USGS stream flow gaging stations in the stretches sampled. Targeted flow levels in the study area were determined by noting internet weather patterns and by checking stream flows at nearby USGS stream flow gaging stations.

Flow was measured, where possible, with a Marsh-McBirney® Model 201 D Water Current Meter. Meter calibration for this equipment is completed by the manufacturer, and verified in the field by checking the battery strength meter.

Stream flow was measured at only one site during the 6/5 survey, because flow levels were fluctuating from the variable rain patterns in the study area. On 9/5, during dry weather, stream flow was static, and flow was measured at 3 sites.

Since there are no stream gages on Wm. Baker Ditch, Shatto Ditch or the Tippecanoe River, stream flows were estimated for the upstream Tippecanoe River site (WTI040-0023). Flow rates of 310 cfs for 6/5 and 305 cfs for 9/5 were determined by contacting USGS (Stewart 2001).

WATER QUALITY ISSUES OF CONCERN

WATER QUALITY STANDARDS LIMITING VALUES

327 IAC Water Quality Standards (IDEM 2000b) that are applicable are summarized as follows:

- Dissolved oxygen, 327 IAC 2-1-6(b)(3): "…shall not be less than 4 milligrams per liter at any time".
- pH, 327 IAC 2-1-6(b)(2):"…no values below 6.0 nor above 9.0…"
- Fluoride, 327 IAC 2-1-6(a)(3) Table 1: shall not …exceed 1.0 mg/L.
- Sulfate 327 IAC 2-1-6(a)(3) Table 1: Sulfates shall not exceed 250 mg/L in all waters.
- Total Dissolved Solids 327 IAC 2-1-6(a)(3) Table 1: Dissolved solids shall not exceed 750 mg/L in all waters.

OTHER CHEMICAL PARAMETERS

The following discussion draws heavily from the USEPA Technical Document on nonpoint source pollution control from agricultural sources (USEPA 2000). Please refer to that document for page references.

Nutrients

Nitrogen (N) and phosphorous (P) are the two major nutrients from agricultural land that degrade water quality. Nutrients are applied to agricultural land in several different forms and come from various sources, including:

- Commercial fertilizer in a dry or fluid form, containing nitrogen (N), phosphorus (P), potassium (K), secondary nutrients, and micronutrients;
- Manure from animal production facilities including bedding and other wastes added to the manure, containing N,P, K, secondary nutrients, micronutrients, salts, some metals, and organics;
- Municipal and industrial treatment plant sludge, containing N,P, K, secondary nutrients, micronutrients, salts, metals, and organic solids;
- Legumes and crop residues containing N, P, K, secondary nutrients, and micronutrients;
- Irrigation water;
- Atmospheric deposition of nutrients such as nitrogen and sulfur (USEPA 2000 p 2-9).

All plants require nutrients for growth. In aquatic environments, nutrient availability usually limits growth. Nitrogen and phosphorus generally are present at background or natural levels below 0.3 mg/L and 0.01 mg/L, respectively. When these nutrients are introduced into a stream or lake at higher rates, aquatic plant productivity may increase dramatically. This process, referred to as cultural eutrophication, may adversely affect the suitability of the water for other uses (USEPA 2000 p 2-10).

Increased aquatic plant productivity results in the addition to the system of more organic matter, which eventually dies and decays. Bacteria decomposing this organic matter produce unpleasant odors and deplete the oxygen supply available to other aquatic organisms. Highly enriched waters will stimulate algae production, consequently increasing turbidity and color (USEPA 2000 p 2-10).

Nitrogen

- All forms of transported nitrogen are potential contributors to eutrophication in lakes, etc. In general, though not in all cases, nitrogen availability is the limiting growth factor for plant growth in marine ecosystems (USEPA 2000 p 2-10).
- Dissolved ammonia above 0.2 mg/L may be toxic to some fish. (USEPA 2000 p 2-11)
- The USEPA has set a limit of 10 mg/L nitrate-nitrogen in water used for human consumption (USEPA 2000 p 2-11).
- Nitrogen is naturally present in soils but must be added to meet crop production needs. Not all nitrogen that is present in soil is available for plant use at any one time. For example, in the eastern Corn Belt, it is normally assumed that about 50% of applied nitrogen is assimilated by crops during the year of application (USEPA p 2-11).
- Total oxidized nitrogen is the sum of nitrate and nitrite nitrogen. In excessive amounts, it contributes to the illness known as methemoglobinemia in infants. As stated above, the limit of 10mg/L nitrate as nitrogen/L (called Maximum Contaminant Level or MCL) has been imposed on drinking water to prevent this disorder (APHA 1998).

- Nitrogen is an essential nutrient for many photosynthetic autotrophs (green plants capable of manufacturing their own food by synthesis of inorganic materials, as in photosynthesis) and in some cases has been identified as the growth-limiting nutrient (APHA 1998).

RESULTS AND DISCUSSION

As mentioned previously, water samples were collected as "grab" samples. Diurnal samples, generally collected over a 24-hour period, characteristically exhibit a noticeable fluctuation in the dissolved oxygen content of the water. This fluctuation is most commonly observed when streams have much aquatic vegetation. Oxygen values in water can vary considerably depending on plants' ability to conduct photosynthesis and respiration. Since large stretches of William Baker Ditch/Shatto Ditch did not appear to contain much aquatic vegetation, it was not felt necessary to collect a diurnal sample.

It should be noted however, that at locations where the 9/4 data indicate that dissolved oxygen exceeded 100% saturation, the water may have been impacted due to enrichment by nutrients. The highest level of ammonia was detected at CR 900 W (WTI040-0011). Phosphorus concentrations were highest at William Baker Ditch at CR 900 W (WTI040-0011), and Shatto Ditch at the confluence with Tippecanoe River (WTI040-0021). Phosphorus was not nearly as high at CR 780 (WTI040-0010), yet the dissolved oxygen saturation was high. The ditch at this location had very low velocity and was barely moving. The pond-like characteristic would favor photosynthetic activity, thus raising the oxygen levels during daylight hours.

Table 2 Field measurements collected during survey.

Site Name	Sample Date	Sample Time	Sample Number	Dissolved O2	Saturation Pct	pH	Water Temp	Specific Conductivity	Turbidity
WTI040-0010	6/5/01	1:45:00 PM	AA04560	7.43	71.6	7.25	12.77	587	25.6
WTI040-0010	9/5/01	11:20:00 AM	AA06858	10.7	118	7.77	18.1	700	18.2
WTI040-0011	6/5/01	2:15:00 PM	AA04563	8.64	*	7.66	13.17	631	50.2
WTI040-0011	9/5/01	11:00:00 AM	AA06860	9.9	119.8	8.27	23.5	775	47
WTI040-0012	6/5/01	2:28:00 PM	AA04564	9.25	84	8.05	12.99	600	118
WTI040-0012	9/5/01	10:30:00 AM	AA06861	7.8	83.4	8.06	16.97	771	10
WTI040-0013	6/5/01	2:40:00 PM	AA04565	9.03	87.7	8.03	12.99	606	37.4
WTI040-0013	9/5/01	10:15:00 AM	AA06862	8.7	96	8.06	17.29	772	10
WTI040-0019	6/5/01	3:08:00 PM	AA04566	9.63	93.4	8.29	12.93	661	31.2
WTI040-0019	9/5/01	9:50:00 AM	AA06863	6.64	75	7.84	16.18	781	10
WTI040-0020	6/5/01	3:23:00 PM	AA04567	9.77	94.6	8.32	12.8	760	39.9
WTI040-0020	9/5/01	9:30:00 AM	AA07069	5.73	60.2	7.5	16.06	698	6
WTI040-0021	6/5/01	2:30:00 PM	AA04568	7.91	*	7.78	12.19	677	0
WTI040-0021	9/4/01	5:00:00 PM	AA06855	10.18	118.2	8.13	21.5	660	5
WTI040-0022	6/5/01	2:45:00 PM	AA04570	8.27	*	7.98	13.81	594	14.1
WTI040-0022	9/4/01	4:30:00 PM	AA06856	7.6	93	7.9	23.07	512	14
WTI040-0023	6/5/01	2:10:00 PM	AA04572	8.31	*	8.02	13.76	597	12.3
WTI040-0023	9/4/01	5:20:00 PM	AA07070	7.3	88.3	7.90	22.96	513	18.0

* - One of two meters was not equipped to measure per cent saturation at 6/5 sample collection time.

Ammonia

Ammonia was not present during runoff conditions of the first (6/5) collection, and was present, as previously mentioned, only at CR 900 West (WTI040-0011) on 9/5, (0.74 mg/L, and the duplicate sample 0.68 mg/L). Ammonia was not detected at other sites, including Tippecanoe River. Warm temperature will quickly cause ammonia to dissipate or convert to nitrates and nitrites. Since ammonia was found during the warmer temperature 9/5 survey, its presence may have been evidence of the cattle being allowed access to the stream.

Nitrate

Nitrates were detected above 10 mg/L at all sites on Wm. Baker-Shatto Ditch on the 6/5 collection. These high levels of nitrate could have come from fertilized fields. During storms, nitrate that has accumulated on land and in soils is transported to streams by water flowing overland, through soils, and by shallow ground water. This is easily true at site WTI040-0011, where vegetation that would help limit runoff is missing from some stream banks.

Samples collected on 6/5 from the Tippecanoe River indicated levels of nitrate at 2.6 mg/L (WTI040-0022), at a stream flow of 310 cfs. (Stewart 2001). The 9/4 sampling at the same site had a nitrate level of 0.31 mg/L at 305 cfs. Pound loading per day for those dates are dramatically different because of the concentration (Table 3). Pound loading per day on those dates decreased from 4,344 pounds during runoff to 510 pounds when the ground was dry.

Table 3 Nitrate Loading Comparison

	6/5/2001			9/4/2001		
SITE	Flow Cfs	Conc mg/L	Load Lbs/day	Flow cfs	Conc mg/L	Load lbs/day
WTI040-0022	310	2.6	4344	305	.31	510
WTI040-0020	2.12	15	172	.067	4.4	1.59

The average of all Tippecanoe River fixed stations mean and median values for nitrate + nitrite was generally lower than Wm. Baker/Shatto Ditch values (Table 6). At Shatto Ditch Site WTI040-0020, the comparison of nitrate pound loading during runoff from the 6/5 sampling event (wet weather) to the 9/4 event (dry weather) was a 108 fold decrease of 172 pounds to 1.59 pounds (Table 3).

Phosphorus

It is estimated that 71% of the non-point source phosphorus load is derived from agricultural activities. Manure and fertilizers increase the levels of available phosphorus in the soil to promote plant growth, but many soils now contain higher phosphorus levels than the plants need. Manures are normally applied at rates needed to meet crop nitrogen needs, yet the ratio of nitrogen to phosphorous in most manures results in over-application of phosphorus (USEPA 2000 p 2-12).

Runoff and erosion can carry some phosphorus to nearby water bodies. Dissolved inorganic phosphorus (orthophosphate phosphorus) is probably the only form directly available to algae. Adsorbed phosphorus transported by the sediment may not be immediately available for aquatic plant growth, but does serve as a long-term contributor to eutrophication (USEPA 2000 p 2-13).

The topsoil of a field is usually richer in nutrients and other chemicals because of past fertilizer and pesticide applications, as well as nutrient cycling and biological activity (USEPA 2000 p 2-14).

Phosphorus, ortho

The lowest level of ortho-phosphorus was 0.096 mg/L at CR 780 (WTI040-0010), the highest level at the next downstream location, 0.34 mg/L (WTI040-0011). Concentrations diminished to 0.056 mg/L before the confluence with the Tippecanoe River (WTI040-0021). Of significance is that the river had higher orthophosphorous than was present in Shatto Ditch. As mentioned previously, orthophosphate is probably the only form of phosphate directly available to algae.

Phosphorous, total

Total phosphorus increased from the CR 780 (WTI040-0010) station near the headwaters, 0.16 mg/L on 6/5, and 0.14 mg/L on 9/6, to CR 900 W (WTI040-0011), 0.52 mg/L on 6/5 and 0.72 mg/L on 9/6. From there, phosphorous diminished as Shatto Ditch flowed on to Tippecanoe River. Upstream Tippecanoe River (WTI040-0022) samples indicated phosphorus 0.15 mg/L and 0.18 mg/L, and, after Shatto Ditch confluence (WTI040-0023), levels decreased, (0.14 mg/L), and increased (0.2 mg/L), on 6/5 and 9/6, respectively.

Both phosphorus and nitrogen levels increase slightly after Shatto Ditch enters Tippecanoe River. However, at these slight differences, it would be difficult to prove this occurs continuously without more sampling. Yet, in nearly all samples, in runoff or during dry season, the nitrogen and phosphorus in the ditch are higher then the mean and median levels of all Tippecanoe River Fixed Station samples (Table 6).

CBOD

Carbonaceous Biochemical Oxygen Demand is used as an indicator of the presence of wastewater, and is a common parameter required for nearly all NPDES non-industrial wastewater treatment permits. As described in Standard Methods (APHA 1998) CBOD "…is used to determine the relative oxygen requirements of unpolluted or polluted waters".

Experience has found that in most rivers, BOD5 rarely exceeds 12 mg/L. But, Carbonaceous BOD, when measured for longer than 5 days, may be higher than 10 mg/L as more digestion continues, indicating organic wastes or wastewater is present in the sample. When the quantity of most NPDES permitted wastewater's enter small streams where the quantity of wastewater effluent is greater than the flow of the stream, then treatment is required to produce an effluent BOD that is less than 10 mg/L.

During runoff on 6/5, the highest values, both under 10 mg/L, were at Wm. Baker Ditch at CR 950 W (WTI040-0012) and Shatto Ditch at the mouth (WTI040-0021). The Tippecanoe River had BOD values upstream (WTI040-0022) and downstream (WTI040-0023) slightly above and below 10 mg/L respectively (Table 6).

Alkalinity

Standard Methods (APHA 1998) defines alkalinity as "…the alkalinity of many waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents". Alkalinity of water describes its acid-neutralizing capacity.

The highest values observed were at Wm. Baker Ditch at CR 950 W (WTI040-0012, Table 6).

Chloride

One of the major anions in water and wastewater, the Water Quality (WQ) Standard is 230 mg/L. No data indicated WQ violations, however, all sites were higher than Fixed Station data from the Tippecanoe River (Table 7).

The highest Chloride value, 49 mg/L was collected at the headwaters, CR 780 W (WTI040-0010).

COD

Chemical Oxygen Demand, or COD, is the amount of a specified oxidant that reacts with the sample under controlled conditions (APHA 1998). The quantity of oxidant consumed is expressed in terms of its oxygen equivalence. COD is often used as a measurement of pollutants in wastewater and natural waters. COD results are commonly 3 to 5 times the BOD5 values.

On 6/5, highest COD values were at Wm. Baker Ditch at CR 200 South (WTI040-0013). All values were higher during the 6/5 survey, when runoff would bring contaminants into the waterways. But, in the 9/5 survey, COD was much lower (Table 7).

TKN (Total Kjeldahl Nitrogen)

TKN is the sum of organic nitrogen and ammonia nitrogen. It is the result of the breakdown of organic compounds to ammonia. Nitrates and nitrites are not detected in TKN analysis.

TKN peaked at Site WTI040-0011 (Table 6).

Animal Wastes

In a review of literature regarding the impacts of long-term animal waste applications on soil characteristics, the positive impacts are the buildup of soil physical properties. Negative impacts include pollution of ground water, phosphorous contamination of surface water, and unfavorable concentrations of copper and zinc when poultry litter and pig manure are applied (USEPA 2000 p 2-16).

Selenium

Selenium, a natural element in soil is essential to human and animal health in very small amounts, but is toxic to some organisms when ingested. Accumulation and concentration of selenium as it moves up the food chain can become toxic (USEPA 2000 p 2-17).

Table 4 Flags and Data Qualifiers Used in Data Tables 5 - 7

Flag	Data Qualification
R	Rejected
J	Estimated
Q	One or more of the QC checks or criteria was out of control
H	The analysis for this parameter was performed out of the holding time. The results will be estimated or rejected on the basis listed below: 1) If the analysis was performed between the holding time and 1½ times the holding time the result will be estimated. 2) If the analysis was performed outside the 1½ times the holding time window the result will be rejected.
D	The Relative Present Difference (RPD) for this parameter was above the acceptable control limits. The parameter will be considered estimated or rejected on the basis listed below: 1) If the RPD is between the established control limits and two times the established control limits then the sample will be estimated. 2) If the RPD is twice the established control limits then the sample will be rejected.
B	This parameter was found in field or lab blank. Whether the result is accepted, estimated, or rejected will be based upon the level of contamination listed below: 1) If the result of the sample is greater than the reporting limit but less than five times the blank contamination the result will be rejected. 2) If the result of the sample is between five and ten times the blank contamination the result will be estimated 3) If the result of the sample is less than the reporting limit or greater than ten times the blank contamination the result will be accepted.
U	The result of the parameter is above the Method Detection Limit (MDL) but below the reporting limit and will be estimated

Table 5 Metal Results from William Baker Ditch/Shatto Ditch Survey

Lsite	Sample Date	Sample Number	Arsenic (ug/L)	Boron (ug/L)	Cadmium (ug/L)	Chromium Total (ug/L)	Cobalt (ug/L)	Copper (ug/L)	Lead (ug/L)	Magnesium (ug/L)	Manganese (Total) (ug/L)	Mercury (ug/L)	Nickel (ug/L)	Selenium (ug/L)	Zinc (Total) (ug/L)
Tippecanoe River*			2.9/2.4	NA	1.0/.9	5.7/5.0	NA	4.3/4.0	6.8/6.0	NA	NA	.1/.1	5.7/6.0	.7/.6	7.5/6.0
WTI040-0010	6/5/01	AA04560	<4	37	<1	<2	<12	<3	<2	18000	86	<0.2	4.2	<3	<10
WTI040-0011	6/5/01	AA04563	<4	44	<1	<2	<12	9	<2	18000	170	<0.2	4.7	<3	12.2
WTI040-0012	6/5/01	AA04564 (M)	<4	<20	<1	<2	<12	4.2	<2	18000	154	<0.2	4.9	<3	11.2
WTI040-0013	6/5/01	AA04565	<4	40	<1	<2	<12	4.3	<2	18000	72	<0.2	4.2	<3	<10
WTI040-0019	6/5/01	AA04566	<4	28	<1	<2	<12	<3	<2	20000	37	<0.2	4.4	<3	<10
WTI040-0020	6/5/01	AA04567	<4	34	<1	<2	<12	<3	<2	20000	17	<0.2	3.8	<3	<10
WTI040-0021	6/5/01	AA04568	<4	37	<1	<2	<12	<3	<2	21000	46	<0.2	4.5	<3	<10
WTI040-0022	6/5/01	AA04570	<4	43	<1	<2	<12	<3	<2	20000	62	<0.2	4.4	<3	<10
WTI040-0023	6/5/01	AA04572 (M)	<4	46.4	<1	<2	<12	<3	<2	19900	65.2	<0.2	4.3	<3	<10
WTI040-0021	9/4/01	AA06855	<5	<50	<1	<2	<12	<3	<2	23000	110	<0.2	4	<5	27
WTI040-0022	9/4/01	AA06856 (M)	<5	<50	<1	<2	<12	<3	<2	20800	62	<0.2	3.9	<5	<10
WTI040-0023	9/4/01	AA06857	<5	56	<1	2.4	<12	<3	<2	21000	78	<0.2	4.2	<5	<10
WTI040-0010	9/5/01	AA06858	<5	<50	<1	<2	<12	<3	<2	27000	300	<0.2	4.5	<5	220
WTI040-0011	9/5/01	AA06860	<5	52	<1	<2	<12	<3	<2	28000	220	<0.2	4.5	<5	<10
WTI040-0012	9/5/01	AA06861	<5	69	<1	<2	<12	<3	<2	29000	140	<0.2	4.8	<5	38
WTI040-0013	9/5/01	AA06862	<5	65	<1	<2	<12	<3	<2	28000	76	<0.2	4.6	<5	14
WTI040-0019	9/5/01	AA06863 (M)	<5	<20	<1	<2	<12	<3	<2	26200	24	<0.2	4.3	<5	<10
WTI040-0020	9/5/01	AA07069	<5	53	<1	<2	<12	<3	<2	23000	180	<0.2	4.3	<5	<10

*Tippecanoe River – Mean/Median values for Fixed Stations on the Tippecanoe River, 1991-1999

Table 6 General Chemistry Results from William Baker Ditch/Shatto Ditch Survey

Lsite	Sample Date	Sample Number	Alkalinity (mg/L)	Hardness** (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Nitrogen, Nitrite (mg/L)	Phos, ortho (mg/L)	Phos, Total (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
Tippecanoe River*			N/A	269/277	.12/.10	N/A	2.2/1.7	N/A	N/A	.11/.09	342/343	.71/.70	6.5/6.1	384/387	15.4/10.0
WTI040-0010	6/5/01	AA04560	190	264	<0.1	14	14	0.12	0.096	0.16	370	1.5 (B)	8.1	420	21
WTI040-0011	6/5/01	AA04563	180	269	<0.1	18	18	0.16	0.34	0.52	390	1.9 (B)	6.9	520	64
WTI040-0012	6/5/01	AA04564 (M)	180	264	<0.1	11	12	0.15	0.21	0.33	380	1.6 (B)	6.3	540	60
WTI040-0013	6/5/01	AA04565	190	259	<0.1	16	16	0.19	0.23	0.36	360	1.4 (B)	6.4	420	33
WTI040-0019	6/5/01	AA04566	220	277	<0.1	17	17	0.18	0.15	0.22	380	1.2	5.3	440	17
WTI040-0020	6/5/01	AA04567	210	287	<0.1	15	16	0.15	0.048	0.065	390	0.84	5	430	6
WTI040-0021	6/5/01	AA04568	220	316	<0.1	13	13	0.15	0.056	0.057	420	1 (B)	4.6	420	5
WTI040-0022	6/5/01	AA04570	210	270	<0.1	2.6	2.9	0.25	0.078	0.15	360	0.98 (B)	6.1	460	21
WTI040-0023	6/5/01	AA04572 (M)	210	270	<0.1	1.8	1.9	0.12	0.085	0.17	370	0.97 (B)	6	400	20
WTI040-0021	9/4/01	AA06855	210	318	<0.1	4.1	4.2 (QJ)	0.025		0.085	490	0.68	3.6	540	<4
WTI040-0022	9/4/01	AA06856 (M)	160	239	<0.1	0.31	0.33 (QJ)	0.023		0.18	380	1.1	7	410	14
WTI040-0023	9/4/01	AA06857	160	232	<0.1	0.34	0.34 (QJ)	<0.01		0.2	380	1.1	7.1	410	20
WTI040-0010	9/5/01	AA06858	250	363	<0.1	1.2	1.2 (QJ)	0.023		0.14	460	1.4	2.6	560	16
WTI040-0011	9/5/01	AA06860	160 (DJ)	353	0.74	3.8	4	0.18		0.72	580	5.6	12.1	680	35
WTI040-0012	9/5/01	AA06861	270	365	<0.1	3.9	4.1 (QJ)	0.15		0.32	530	0.96	7.1	600	<4
WTI040-0013	9/5/01	AA06862	260	351	<0.1	2.9	2.9 (QJ)	0.021		0.34	560	1.2	6.8	600	8
WTI040-0019	9/5/01	AA06863 (M)	260	360	<0.1	3.9	4 (QJ)	0.019		0.38	560	1.1	6.3	620	<4
WTI040-0020	9/5/01	AA07069	240	336	<0.1	4.4	5 (QJ)	0.54		0.2	480	1	4.2	540	4

*Tippecanoe River – Mean/Median values for Fixed Stations on the Tippecanoe River, 1991-1999
** as CaCO3, Calculated

Table 7 Bacteriological and Miscellaneous Chemistry Results from William Baker Ditch/Shatto Ditch Survey

Lsite	Sample Date	Sample Number	CBOD-LR (mg/L)	COD (mg/L)	Coliforms, Total (CFU/100mL)	E_ Coli (CFU/ 100mL)	Calcium (ug/L)	Chloride (mg/L)	Fluoride (mg/L)	Potassium (ug/L)	Sodium (ug/L)	Sulfate (mg/L)
Tippecanoe River*			N/A	21.9/20.2	N/A	590/90	NA	25/22	.20/NA	NA	NA	47/48
WTI040-0010	6/5/01	AA04560		25	>2419.2	>1	76000	49	0.17	<5000	10000	34
WTI040-0011	6/5/01	AA04563	3.7	34	>2419.2	**>2419.2**	78000	32	0.13	5200	12000	37
WTI040-0012	6/5/01	AA04564 (M)	15.8	30	>2419.2	**>2419.2**	76200	31	0.13	4450	11600	36
WTI040-0013	6/5/01	AA04565		42	>2419.2	**>2419.2**	74000	31	0.13	<5000	11000	36
WTI040-0019	6/5/01	AA04566		25	>2419.2	**1300**	78000	29	0.12	<5000	10000	44
WTI040-0020	6/5/01	AA04567		17	>2419.2	**344.8**	82000	24	0.11	<5000	12000	48
WTI040-0021	6/5/01	AA04568		13	>2419.2	**1300**	92000	36	0.14	<5000	8900	59
WTI040-0022	6/5/01	AA04570		28	>2419.2	**290.9**	75000	62	0.18	<5000	12000	57
WTI040-0023	6/5/01	AA04572 (M)		16	>2419.2	**410.6**	75200	26	0.18	<5000	15000	60
WTI040-0021	9/4/01	AA06855	3.8	<5			89000	30	0.19	3500	11000	74
WTI040-0022	9/4/01	AA06856 (M)		24			61400	33	0.2	2780	15700	51
WTI040-0023	9/4/01	AA06857	5	16			58000	33	0.2	3000	17000	51
WTI040-0010	9/5/01	AA06858	8.6	11	>2419.2	115.3	100000	34	0.15	1400	9800	77
WTI040-0011	9/5/01	AA06860	15.7	22 (DJ)	>2419.2	**>2419.2**	95000	56	0.16	9600	21000	58
WTI040-0012	9/5/01	AA06861	4.7	<5	11199	**275.5**	99000	56	0.16	6100	23000	56
WTI040-0013	9/5/01	AA06862	4.8	7.6	>2419.2	**307.6**	95000	56	0.16	7100	23000	56
WTI040-0019	9/5/01	AA06863 (M)		11	24192	172.5	100000	49	0.13	6700	19000	70
WTI040-0020	9/5/01	AA07069	3.3	5.4	>2419.2	**488.4**	97000	30	0.13	5000	9300	75

*Tippecanoe River – Mean/Median values for Fixed Stations on the Tippecanoe River, 1991-1999

CONCLUSION

Construction of the CFO facility was not completed and not in operation by the time this survey was conducted. Therefore, this survey illustrates water quality of Wm. Baker Ditch, Shatto Ditch and the Tippecanoe River before the affects, if any, of the CFO. Water sample data collected indicates nitrates are at high levels after runoff conditions carry them into the streams at nearly all locations. The worst location is above site WTI040-0011 at CR 900 West, where the stream banks are denuded, there are no trees, and cattle can enter the stream. All other sites had high grass in the ditch with bordering cropland and little evidence of cattle having access to the stream. At the CR 900 W site, cattle were observed in the field through which the stream flowed. Typical for grazed fields, the grass was shorter in the pasture and missing on the stream banks. The banks were exposed to runoff. There were no trees in this stretch to shade the stream, so that higher stream temperatures would affect the rates of in-stream chemical reactions, or, the natural self-purification capacity of the streams. Channel morphology has changed considerably by increasing stream width from animals wading in the stream and loss of riparian vegetation, which allows the stream temperatures to increase. "Problems associated with grazing and pasture lands include reduced riparian cover, exposed stream banks, high sediment levels, elevated stream temperatures, higher nutrient levels…" (USEPA 2000 pp 2-22,23).

Some Tippecanoe River analytes were higher than Wm. Baker or Shatto Ditch. Conversely, high turbidity shows evidence of storm effect during the 6/5 survey (Table 2). This is to be expected, since nutrients were highest during runoff (6/5). The highest suspended solids data also occurred on 6/5, with the highest at site WTI040-0011.

The only WQS violation noted was from high *E coli* bacteria counts. The WQS states *E coli* "…shall not exceed…two hundred thirty five (235) per one hundred (100) milliliters in any one (1) sample in a thirty day period" (IDEM 2000b).

Heavy metals were either not detected or were detected at concentrations well below levels of concern (Table 5). Metals are usually found in manures and bedding material.

RECOMMENDATIONS

There are steps that could be taken now to improve surface water quality.

- Animals should be fenced away from Wm. Baker Ditch/Shatto Ditch;
- All animal wastes and runoff should be prevented from entering the ditch by allowing growth or placement of buffer strips along waterways that are not accessible to animals. Buffer strips have been shown to be effective in reducing nitrates and coliform bacteria in runoff (Fajardo et al 2001);
- It is recommend that Kosciusko County Health Department investigate the failing septic tank found on CR 200 S (WT040-0013);
- This report has been forwarded to the Kosciusko County Soil and Water Conservation District (SWCD) as the primary contact for any technical assistance on the installation of agricultural best management practices (BMPs);
- We have also informed the Watershed Management Section of the Indiana Department of Environmental Management (IDEM) of the findings of this report. This Section within

IDEM works with the SWCDs in providing grant money to help with nonpoint source pollution issues in Indiana;

- It is recommended that the Wm. Baker Ditch/Shatto Ditch be considered for inclusion on the Federal Clean Water Act, Section 303(d) list of impaired waterbodies.

BIBLIOGRAPHY

American Public Health Association (APHA), American Water Works Association, and Water Environment Federation. 1998. *Standard Methods for the Examination of Water and Wastewater. (20th ed).* Washington D.C., American Public Health Association.

Beckman T, Editor. 2000. *Surveys Section Field Procedure Manual. Revised April 2000.* Indiana Department of Environmental Management, Office of Water Management, Assessment Branch, Surveys Section, Indianapolis, Indiana. IDEM 032/02/006/2000

Boswell S. 2001. *Sampling Plan for the Investigation of Surface Water Quality of Wm. Baker Ditch and Shatto Ditch, Kosciusko County, Indiana, for 2001.* Indiana Department of Environmental Management, Office of Water Quality, Assessment Branch, Surveys Section.

Farjardo JJ, JW Bauder, and SD Cash. 2001. *Managing nitrate and bacteria in runoff from livestock confinement areas with vegetative filter strips.* Journal of Soil and Water Conservation. Vol 56. No 3. 2001.

Foltz, RM. 2000. Personal Correspondence dated November 29, 2000.

Indiana Department of Environmental Management (IDEM). 2000. Correspondence to Mr. Cal Jackson, Creighton Brothers LLC, PO Box 1058, Warsaw, Indiana, 46581, dated April 30, 2000, regarding Confined Feeding Operation, Section 23, T32N, R4E, Kosciusko County, "Wray Farm", Farm ID #6087, Approval Number AW-4914.

Indiana Department of Environmental Management (IDEM). 2000b. *Indiana Environmental Rules: Water 2000 Edition. Title 327 Article 2: Water Quality Standards*. Department of Environmental Management, State of Indiana, Indianapolis, Indiana.

Indiana Department of Environmental Management (IDEM). 2000c. *Review of the Analytical Data for the Quality of the Water in the Ditch That Flows Adjacent to Creighton Brothers Farm in Mentone, Kosciusko County, Indiana.* Office Memorandum from James P. Caylor, dated March 10, 2000. Indiana Department of Environmental Management, Office of Land Quality, Science Service Branch.

Stewart J. 2001. Personal phone conversation with USGS on 11/16/01 about estimation of quantity of flow in Tippecanoe River on survey dates.

Still T. Undated. Kosciusko County Health Department correspondence (Includes laboratory reports conducted by Turner Technologies)(No cover letter)

United States Environmental Protection Agency (USEPA). 2000. *National Management Measures to Control Nonpoint Source Pollution From Agriculture*. DRAFT 8/31/00. United States Environmental Protection Agency, Nonpoint Source Control Branch, Office of Water, Washington, DC. USEPA Contract # 68-C99-249. Available at http://www.epa.gov/owow/nps/agmm/.

United Stated Environmental Protection Agency (USEPA). June, 1992. *Compendium of water-scale models for TMDL development.* Office of Wetlands Oceans, and Watersheds, Office of Science and Technology, Office of Water, Washington DC.

United States Geological Survey (USGS). *Environmental Setting and Natural Factors and Human Influences Affecting Water Quality in the White River Basin.* Indiana Water Resources Investigations Report 97-4260.